U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN No. 216.

THE CONTROL OF THE BOLL WEEVIL,

INCLUDING RESULTS OF RECENT INVESTIGATIONS.

BY

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ENTOMOLOGY,
Washington, D. C., February 3, 1905.

SIR: I transmit herewith a manuscript entitled "The Control of the Boll Weevil, Including Results of Recent Ivestigations," prepared by Mr. W. D. Hunter, special agent of this Bureau in charge of experimental work with the cotton boll weevil. This paper will replace Farmers' Bulletin No. 189. It contains the previous recommendations of the Bureau of Entomology regarding the means of mitigating the damage by this very serious pest, with such minor modifications as have been made necessary by the work of the past season. In addition, various topics, such as the territory infested, the present status of State quarantines against the boll weevil, and other matters, are considered. I recommend that it be issued as a Farmers' Bulletin

Respectfully,

L. O. HOWARD,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

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THE CONTROL OF THE BOLL WEEVIL.

RECOMMENDATIONS.

The work of the Bureau of Entomology for several years has indicated that there is not even a remote probability that the boll weevil will ever be exterminated. As a matter of fact, no injurious insect has ever been exterminated. Some species, like the Rocky Mountain locust in this country, have died out more or less on account of climatic influences, and reasonably effective methods of combating others, like the Phylloxera in France, have been perfected.

Although the very large yields of cotton of former times may no longer be possible in the region now infested by the boll weevil, it is entirely feasible to produce cotton at a margin of profit that will compare favorably with that resulting from the production of most of the staple crops of the United States by following what has become generally known as the cultural method. This method consists of the following changes and modifications of the system of cotton raising, made necessary by the boll weevil. It was originally suggested by a careful study of the life history and habits of the pest, and naturally any improvements that may eventually be made will be the result of a continuation of that study. It has now been tested successfully on a large scale by the Bureau of Entomology, as well as by many planters, during three seasons. Of greatest advantage is the reducing of the numbers of the weevils by the destruction of the plants in the fall. The advantage thus gained is followed up by bending every effort toward procuring an early crop the next season.

(1) Plant early. If possible, plant seed of the varieties known to mature early, or obtain seed from as far north as possible. This recommendation is made as a suggestion for the benefit of those planters who have not taken care in the selection of the cotton seed for planting on their plantation. By far the best method for obtaining early seed is by selection in the field.

It is much better to run the risk of replanting, which is not an expensive operation, than to have the crop delayed. The practice of some planters of making two plantings to avoid having all the work of chopping thrown into a short period is very bad policy from the boll-weevil standpoint.

Early cotton of improved varieties has yielded from two to three times as much as native cotton under the same conditions, and in many cases much more. Planted at the same time, the early varieties begin to bloom much earlier than native cotton.

Early-planted fields of either native or improved varieties have almost invariably yielded twice as much as late-planted ones.

The early varieties, in general having a small stalk and short taproot, are adapted only for rich soil. They also fail to grow well in the very light, drifting sandy loams of many of the river valleys of Texas, which, in long seasons before the advent of the boll weevil, often produced the largest yields. In these situations early varieties will yield but little more than native cotton.

(2) Cultivate the fields thoroughly. The principal benefit in this comes from the influence that such a practice has upon the constant growth and consequent early maturity of the crop. Very few weevils are killed by cultivation. Much of the benefit of early planting is lost unless it is followed by thorough cultivation. In case of unavoidably delayed planting, the best course for the planter to pursue is to cultivate the fields in the most thorough manner possible. Three choppings and numerous plowings constitute the thorough system of cultivation that is made necessary by the boll weevil. The old plantation rule for the cultivation of cotton, "Once a week and once in the row," is an excellent one.

(3) Plant the rows as far apart as experience with the land indicates is feasible, and thin out the plants in the rows thoroughly. On land which in normal seasons will produce from 35 to 40 bushels of corn the rows should be 5 feet apart. Even on poor soil it is doubtful if the distance should ever be less than 4 feet.

(4) Destroy, by plowing up, windrowing, and burning, all the cotton stalks in the fields as soon as the weevils become so numerous that practically all the fruit is being punctured. This will generally not be later than the first week in October. Merely cutting off the stalks, by means of the triangular implement used for that purpose throughout the South, is by no means as effective as plowing, because the stumps remaining give rise to sprouts which furnish food until late in the season to many weevils that would otherwise starve. The plowing, moreover, serves to place the ground in better condition for early planting the following spring. In some cases turning cattle into the fields is advisable. Aside from amounting to a practical destruction of the plants, grazing of the cotton fields furnishes considerable forage at a time when it is generally much in demand. Nevertheless, cattle should never be turned into cotton fields in which Johnson grass has become started.

Recommendations 1, 2, and 3 are all aimed toward avoiding damage by hastening the maturity of the plants and do not involve the actual destruction of the weevils. Recommendation 4, however, reduces the numbers of the pests by destroying the very great proportion developing late in the fall, and is consequently directly remedial.

(5) It is known that at present fertilizers are not used to any considerable extent in cotton producing in Texas. There is, nevertheless, no doubt

that they should be—not that the land is poor, but that earlier crops may be procured. At present it is sufficient to call attention to the fact that it has been the uniform experience of experiment stations and planters in the eastern part of the belt that certain fertilizers, especially those involving a large percentage of phosphoric acid, have a strong tendency toward hastening the maturity of the plants.

The recommendations above made constitute the essential steps in the cultural system of averting damage by the boll weevil. In addition to these steps, however, all operations which assist in the growth of the crop are of decided advantage in regions infested by the boll weevil. There is thus a distinction between the cultural system of averting damage by the boll weevil and the proper system of cultivation of cotton. The terms are by no means synonymous. As a matter of fact the cultural system of averting damage by the boll weevil in some cases implies operations that would not be the proper ones in all cases for the production of the largest crop were the pest not present. This is especially the case in the early fall destruction of the plants, and also to some extent in the selection of early maturing varieties and in early planting itself.

A number of devices are possible for hastening the maturity of the crop in addition to those mentioned. For instance, thorough preparation of the land before planting is of very great importance; the packing of the soil by means of a roller immediately after the seed is planted insures rapid germination, and consequently also assists in advancing the maturity of the crop.

Necessarily the proper application of fertilizers is a complicated matter. Only the most general rules are possible for all conditions. The different soils on single farms require different compositions. Nevertheless, it can be stated that acid phosphate is the principal ingredient that the cotton plant requires, and that it has a very important function in hastening maturity. It also largely controls the action of the other essential elements, nitrogen and potash. The work of the southern experiment stations has shown that the nearest approach to a general formula for all soils is one that provides 10 per cent of available phosphoric acid, 3 per cent of ammonia, and 3 per cent of potash. This proportion is reached approximately by mixing 1,200 pounds of acid phosphate with 600 pounds of cotton-seed meal and 200 pounds of kainit.

The cultural means of obtaining an early crop, such as thorough preparation of the soil, selection of variety, early planting, fertilization, and cultivation will be dealt with fully in a Farmers' Bulletin, by Dr. R. J. Redding, director of the Georgia Agricultural Experiment Station, which will soon be issued.

INTRODUCTORY.

The present bulletin is designed to bring together discussions of some of the features of the boll weevil problem in the United States that are of most immediate interest. Among such matters are the more recent developments regarding (1) the cultural system of avoiding damage by the pest, (2) the territory affected, (3) the loss occasioned during the season of 1904, (4) the present status of quarantine regulations, and (5) some minor matters. Some information, as, for instance, the description of the weevil and some portions of the discussions of the damage caused by the pest, are reproduced from Farmers' Bulletin No. 189, which was published in January, 1904. It is not intended in the present bulletin to include all of the results of the experimental work conducted during the season. In a general way, the work of this season has demonstrated the value of the recommendation that has been made previously. Any modification of the present approved system of controlling the pest must be the result of the continuation of experimental work during a series of seasons. Some modifications have been suggested by the work during the past season, but before definite general recommendations can be made it will be necessary for the experiments to be repeated during other seasons when the climatic conditions may be essentially different. It is the purpose of the Bureau of Entomology to incorporate the results of all this experimental work as soon as possible in an extended account of all that is known concerning the methods of combating the pest. The present publication includes all recommendations which have been demonstrated to have a general bearing and to be applicable to all portions of the region now infested.

The experimental field work of the Bureau during 1904 was done on experimental farms at a number of localities in Texas, where local conditions presented special problems in the attempt to control the boll weevil. The following is a list of the experimental farms which were in operation:

County.	Planter.	Acreage.
Anderson	B. H. Gardner	100
Bexar	J. M. Styers	40
Karnes	W. H. Leckie	68
Limestone	J. L. Cogdell	65
Navarro	R. Beaton and W. T. Ferguson	94
Robertson	W. C. Anderson and E. S. Peters	225
Travis	Jefferson Johnson	100
Victoria	S. G. Reed and W. T. Tipton	85
Washington	J. E. Routt	100
Wharton	A. P. Borden	100
Williamson	C. C. Hooper	100

This work was conducted under contracts, according to which the planter agreed to prepare the soil, plant, and care for the crops in

accordance with the directions of the Bureau of Entomology. The prime object in the location of a farm at any particular point was to obtain typical conditions for an area which possessed characteristics that differentiated it from other cotton-producing areas in Texas. The most sharply defined of the different weevil regions in Texas is the portion of the State where volunteer or seppa cotton exists normally. The green parts of the plant persisting through the winter furnish the weevils an abundance of food in this region, of which they are deprived in other parts of the State. The consequence is that an unusually large number pass the winter successfully. Damage consequently begins in the fields earlier the following season here than elsewhere. This area normally extends about as far north as to a line between San Antonio and Houston. Another quite distinct region as regards its effect upon the habits of the boll weevil is found in the valley area of the central portion of the State. Between the latitudes of Navasota and Waco, approximately, there is a region in which no volunteer or seppa cotton is normally present. Nevertheless, the long season of growth of the plants furnishes the weevil food and means of reproduction until very late in the season. The cotton fields have generally all been cleared from forest land. There is consequently an abundance of timber which furnishes ideal cover for the hibernating weevils. In this region it has been the practice to devote exceptionally large areas or individual plantations to cotton. This is the result of the fact that cotton has been the most certain crop that can be produced, and that there are decided restrictions to diversified farming. There is not the opportunity which occurs south of this region for the cultivation of sugar cane and rice, and at the same time wheat and some other cereals which grow well north of the region under consideration do not prosper here. The limits of diversified farming are further restricted by the fact that many soils are not suitable for the cultivation of corn. The labor and general economic conditions have become centered in the production of one crop, and this has a very important bearing on the application of the cultural system. There is another distinct region which comprises the river valley area of the northern portion of the State. The hill region of central Texas, the prairie region of west central and northern Texas, the east Texas pine woods region, and the irrigated region of the western portion of the State also furnish peculiarities which cause the habits of the weevil to be modified, and consequently change materially the necessary means for controlling it. Of course there are many other regions in Texas where local conditions, as of soil, might bring about subdivisions of the regions that have been mentioned. However, these strictly local conditions concern themselves more with changes in the simple cultivation of the crop than with changes in the general system of mitigating damage by the boll weevil.

DESCRIPTION OF THE BOLL WEEVIL.

The following account of the means for identifying the boll weevil is taken mainly from Farmers' Bulletin No. 189.

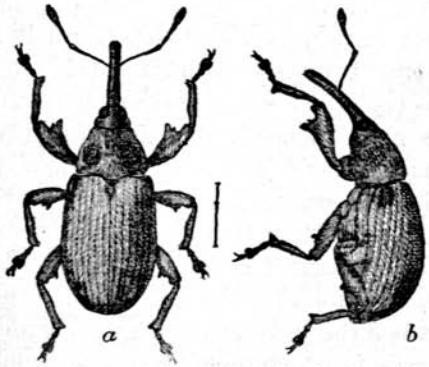

FIG. 1.—Cotton boll weevil: *a*, beetle from above; *b*, same, from side—about five times natural size (original).

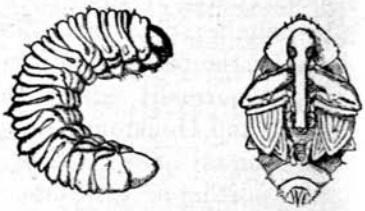

FIG. 2.—Cotton boll weevil: larva at left, pupa at right—about five times natural size (original).

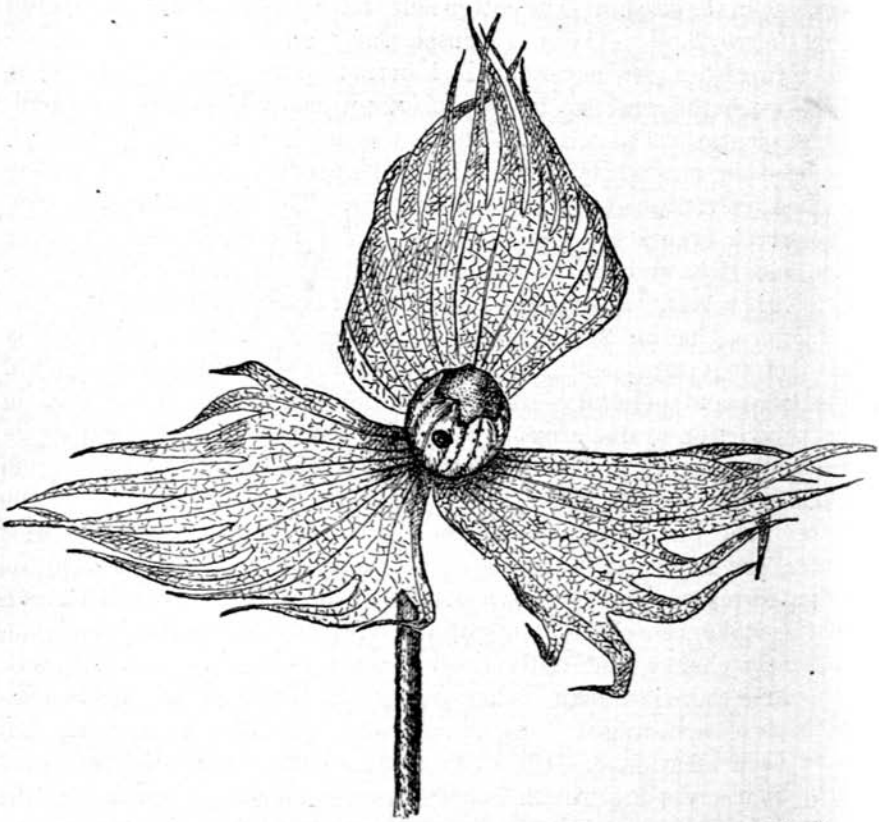

FIG. 3.—Cotton square flared, showing egg puncture of boll weevil—natural size (original).

Every intelligent planter in the weevil-infested area should be able to determine the presence of the pest by its appearance and the evidences of its work; but planters who have never seen it may often be in doubt as to whether some insect found damaging the crop is the boll weevil, or whether flaring and falling of the squares is caused by some other unseen insect pest or by climatic conditions. For the benefit of planters outside of the present weevil territory, in regions where the pest is more or less likely to be found at any time, the following description of the insect and its work is given. It is believed that this description will enable any planter to determine whether the pest is at

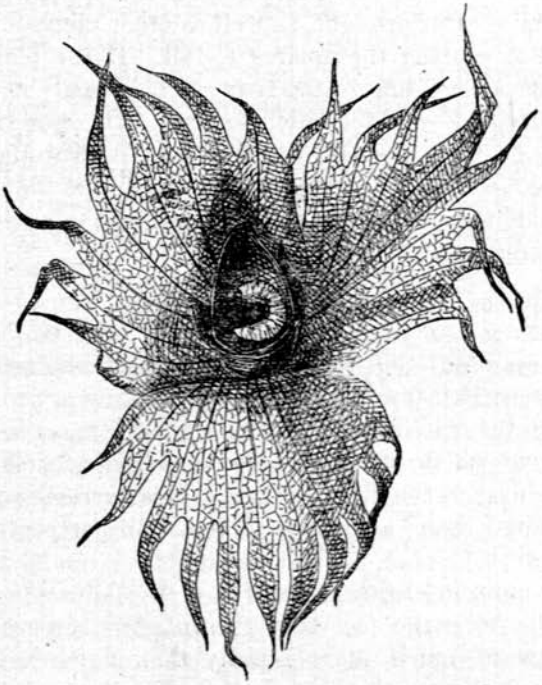

FIG. 4.—Cotton square cut open, showing boll weevil larva in position—natural size (original).

work in his field, so that he may take the necessary steps to fight it at the earliest moment.

The adult weevil averages about one-fourth of an inch in length, ranging from one-eighth to one-third inch, with the breadth about one-third of the length. This measurement includes the snout, which is about one-half of the length of the body. The color is a grayish or a yellowish brown. The general form will be understood from fig. 1. The insect exists in four stages—egg, larva, pupa (fig. 2), and adult. All the stages, except the adult, occur only within the cotton square or boll. The egg is deposited by the female weevil in a cavity formed by eating into the fruit of the plant (fig. 3). It hatches, under normal

conditions, in about 3 days, and the grub immediately begins to feed. In from 7 to 12 days the larva or grub passes into its pupal or transformation stage, corresponding to the cocoon stage of the silkworm. This stage lasts from 3 to 5 days. Then the adult weevil issues, and in about 5 days begins the production of another generation. Climatic conditions cause considerable variation in the duration of these stages, but on an average it requires from 2 to 3 weeks for the weevil to develop from the egg to the adult. The plainest indication of the presence of the weevil in a cotton field is the flaring (fig. 3) and falling of the squares or forms, which takes place generally between 5 and 10 days after the egg is deposited. However, as all planters are aware, heavy rains after drought, as well as other climatic conditions, have the effect of causing the squares to fall. If the planter should observe an unusual shedding of the fruit, he may easily determine the cause by gathering a few of the fallen squares. If, upon cutting open these squares, he finds a small, whitish, curved grub (fig. 4), there can be little doubt that the cause of the trouble is the boll weevil. Specimens should then be securely packed and sent to an entomologist for final determination.

TERRITORY AFFECTED.

During the season of 1904 the normal increase in infested territory occurred. About 15,000 square miles, representing approximately an area devoted to the cultivation of cotton of 900,000 acres, the normal production from which would be in the neighborhood of 350,000 bales, became invaded for the first time. This increases the infested area in the United States at present to about 32 per cent of the total cotton acreage.

One of the most interesting features of the situation during the past season has been the fact that the infested territory has been extended eastward much more rapidly than northward. Careful examinations of the portions of Indian Territory which the boll weevil is likely to reach first have failed to reveal any infestation. In fact, on the north the limitation of the infested territory remains practically the same as last year. This applies, however, only to the total infested area in which even isolated colonies of the pest have been found to exist. There has been a gradual northward advance of the limits of the region of what may be termed "gross infestation;" that is, where the weevils are to be found in considerable numbers in all cotton fields. This advance has extended from about the latitude of the northern portion of Ellis County to the latitude of the southern portions of Denton and Collin counties, a distance of about 36 miles.

The situation mentioned in the preceding paragraph leads to speculation as to whether the pest has not reached a northern limit beyond

which its spread will be prevented or at least checked by climatic conditions. During the past year it has been found that there is at least one full generation less at Terrell, Tex., than at Victoria, Tex., 275 miles south of that place. With the very rapid multiplication of the pest, this means greatly lessened actual damage. The time when the maximum number of weevils per acre is produced is made considerably later, with a consequent manifest advantage to the crop. The lessened number of generations is due to three principal factors: (1) Later emergence from hibernating quarters; (2) greater time required for the development of the several stages; and (3) the earlier date of the first killing frost. These considerations would, theoretically at least, cause the weevil problem to become a much less serious one in extreme northern Texas than it has been in regions that have heretofore been infested, and the observations of the last season bear out this supposition. However, it is to be expected that there will be some adaptation on the part of the weevil to the climatic conditions in newly invaded regions, and this introduces considerable uncertainty in any prediction regarding future damage. The present indications are that the greatest damage by the pest will always be in the region south of the latitude of Dallas, Tex.

To the east there has been a general extension of the infested territory of about 50 miles. The pest has been found east of the Red River at three points in Louisiana, namely, Lockwood, Grand Ecore, and Shreveport. In that State the greater portion of six parishes is known to be generally infested, while in three others the weevils are known to occur in certain localities. Special opportunities for studying this spread were given by the cooperation which the Bureau of Entomology carried on with the Louisiana crop pest commission. It was found that there was an advance early in the fall due to the fact that the weevils were carried from place to place in seed for planting purposes. This was followed by considerable increase in territory due to the conveying of the seed cotton to the gins, and, most important, there was an advance due to an actual migration in August and September, which in many cases reached far beyond the limits of the territory covered by the first two means which have been mentioned.

At frequent intervals during the past season (1904) accounts of the occurrence of the boll weevil at various points far beyond the limits of the infested territory indicated upon the accompanying map (fig. 5) have appeared in the newspapers. It seems likely that the pest may at any time be carried to points far outside of the present infested territory through the ordinary shipments of cotton products. There is also some possibility that persons who have received live specimens from Texas for experimentation with supposed remedies may inadvertently introduce them into uninfested fields. In consequence of these probabilities, the Bureau of Entomology has devoted special

attention to the reported occurrence of the weevil outside of the region indicated upon the accompanying map. A number of reports originating in Louisiana, Arkansas, and Indian Territory have been investigated by entomologists connected with the Bureau. Through cooperation with State and station entomologists the Bureau has obtained specific information about reports originating in Georgia,

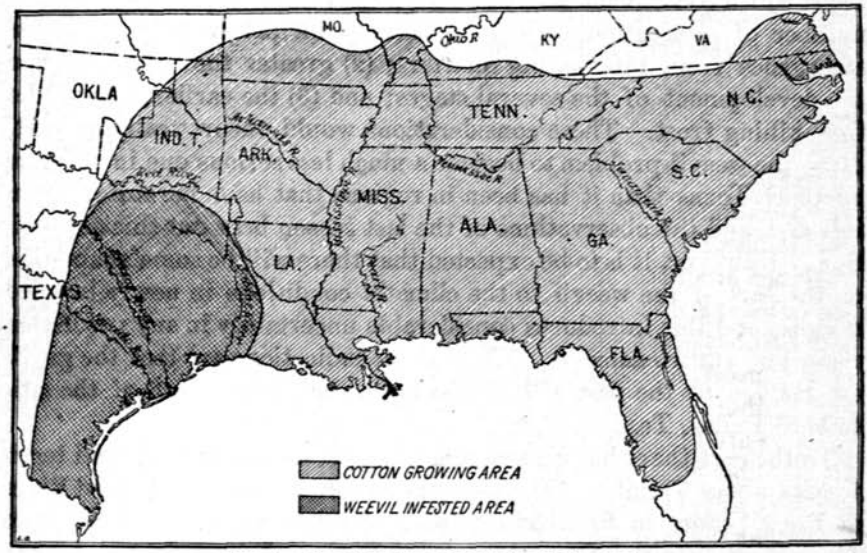

FIG. 5.—Map of territory infested by boll weevil.

South Carolina, and elsewhere. All such reports investigated have been found to rest upon a mistaken identification of some of the numerous insects more or less resembling the boll weevil which have been found in cotton fields.

DAMAGE CAUSED BY THE BOLL WEEVIL.

The following table, reproduced from Farmers' Bulletin No. 189, shows the great damage caused by the boll weevil:

Comparative estimate of amount of damage by cotton boll weevil.

Typical counties in which weevil was not present in 1899, but was present in 1902.			Typical counties in which weevil was not present in either 1899 or 1902.		
County.	Product in commercial bales.		County.	Product in commercial bales.	
	1899.	1902.		1899.	1902.
Caldwell	47,473	23,133	Montague	15,064	16,981
Colorado	30,923	11,493	Cooke	11,905	11,012
Fayette	73,238	31,200	Grayson	40,871	54,087
Gonzales	44,131	25,351	Fannin	59,802	70,540
Grimes	26,541	12,135	Lamar	49,193	59,269
Lavaca	42,484	22,906	Wise	17,556	18,869
Montgomery	10,272	3,660	Denton	20,381	24,541
San Jacinto	8,826	3,044	Collin	49,077	47,344
Travis	60,078	28,382	Hunt	50,317	49,713
Wharton	27,383	12,870	Delta	24,705	26,256
Total	371,349	174,174	Total	338,871	378,612
Decrease ..... per cent.		53	Increase ..... per cent.		11

The first section of the above table shows a comparison of the production in ten counties in Texas in 1899, when the weevil had scarcely reached them, and in 1902, when it had multiplied to such an extent as to be found in great numbers in practically all cotton fields. These wo years were selected for comparison for the reason that they were practically identical in amount and distribution of rainfall and in other essential crop conditions. The second part of the table gives a comparison of the production during the same years in ten other leading counties situated so far north that the weevil had not affected them in either of the two years used for comparison. It will be noticed that while in the counties of the first series there had been a decrease in production of 53 per cent, in the counties of the second series there had been an increase of 11 per cent. There seems to be no reason why the cotton production of the counties of the first series would not have increased at about the same rate as was the case in those of the second series had it not been for the damage caused by the weevil. This makes it fair, it is believed, to conclude that the approximate damage caused by the insect was the sum of the decrease in one case and the increase in the other, or about 64 per cent.

There are two sources of possible error in these figures. One is in the likelihood of a change in acreage between 1899 and 1902 that may not have affected the two regions alike, and the other is in the probability that the two seasons were not exactly similar. In relation to the first point it must be stated that increases in acreage are generally the result of conditions of the markets that would affect the whole State alike, and that if there were any increase in these years it would probably have been very much alike in either case. As to the possibility of an appreciable difference in the seasons, it must be stated that the two regions are comparatively close together, and that a careful examination of the records shows that they were remarkably alike in all important respects. Nevertheless, it is the tendency of planters, as soon as the weevil becomes a serious menace, to devote more of their land to other crops. Accurate figures on this point are not obtainable, but on the whole an allowance of a reduction of this kind that would account for 10 per cent decrease in production would be ample. It therefore seems to the writer that a figure in the neighborhood of 50 per cent represents a very fair approximate estimate of the loss.

Upon the foregoing basis, assuming that there is a loss of about 50 per cent in newly invaded regions, but with an offset due to improved methods in older regions, it seems very conservative to state that, during the season of 1904, the weevil caused a reduction of at least 450,000 bales, representing a value, including that of the seed, of about $22,000,000.

There are many interesting features connected with the relation between the damage of the weevil and the present very large cotton crop (estimated by the Bureau of Statistics of this Department, December 3, 1904, as 12,162,000 bales). The question has been raised as to why the weevil is a great menace in view of this large production and the fact that the pest has now invaded at least 32 per cent of the cotton acreage in this country. The following appear to be the principal reasons for the present large production:

(1) The high price of cotton just prior to the time of planting the crop of 1904 undoubtedly had the effect of increasing the acreage considerably.

(2) The boll weevil has not yet reached numbers in all its range sufficient to appreciably reduce the crop. The map on page 12 outlines the total area in which any weevils are known to occur. In perhaps 10 per cent of the territory thus considered infested only isolated colonies occur, and the general production has not yet been curtailed. In some of the northern counties of Texas the production could not have been reduced by the weevil, although the statistics show considerable variation between the crops produced for the past several years on account of changes in acreage and the ravages of other insects, like the bollworm.

(3) Throughout the portion of Texas where the bulk of the crop is produced—that is, north of about the latitude of Bremond—various conditions combined to cause an unusually small number of weevils to hibernate successfully during the winter of 1903–4. The principal factor in this situation was the very early date of the first killing frost, which was about thirty days prior to the average date for the past fifteen years. This early frost destroyed a great number of immature weevils in the squares and bolls which would otherwise have passed through the winter to damage the crop in spring.

(4) An important factor which has contributed to the production of a large crop in the region just mentioned has been a lessened degree of damage by the bollworm. It is estimated by Mr. A. L. Quaintance, who has been in charge of a special investigation of the bollworm, that the pest could not have caused more than half the damage in 1904 that was caused by it in 1903.

(5) The growing season was unusually favorable. The average condition of the growing crop in Texas, from May to September, inclusive, as published by the Bureau of Statistics of this Department, was 82 in 1904, as against 72.5 in 1903. The average condition for 1904 was, in fact, much higher than in even the season of the largest crop ever produced, namely, 1900, when the average condition reported for the months mentioned was 77.6.

(6) The season of 1904 was exceedingly favorable during the time of picking the crop, resulting in an unusually small loss of lint from rains.

(7) The large amount of work done by the Department of Agriculture and commercial bodies which imported many carloads of improved seed doubtless contributed to the large crop produced.

A general idea of the effect of the ravages of the boll weevil in reducing the crop in Texas may be obtained from the following table:

Comparison of cotton acreage and production in Texas and Louisiana, in equivalents of 500-pound bales.

Year.	Texas.		Louisiana.	
	Acreage.	Crop.	Acreage.	Crop.
	Acres.	*Bales.*	*Acres.*	*Bales.*
1899	6,642,309	2,609,018	1,179,156	700,352
1900	7,041,000	3,438,386	1,285,000	705,767
1901	7,745,100	2,502,166	1,400,650	840,476
1902	8,006,546	2,498,013	1,662,567	882,073
1903	8,129,300	2,471,081	1,709,200	824,965
1904	8,704,000	3,030,433	1,940,000	893,193

It will be seen that while the acreage in Texas and Louisiana has been increasing at about the same proportion, the crop in Texas has decreased annually for the past six years (with two exceptions—1900 and the present year), while the crop in Louisiana has increased annually (with one inconsiderable exception—in 1903). That the boll weevil is the cause that has prevented Texas from keeping pace with Louisiana will be admitted by all. The exceptional years, 1900 and 1904, in which the production in Texas did not decrease, were undoubtedly those in which the conditions for the cotton plant were unusually favorable. Moreover, it is to be noted that in the first of these two years the pest had not reached far into the most productive counties.

A VARIETY TEST.

In order to test the suitability of a number of varieties of cotton for planting in weevil-infested regions, during 1904 the Bureau of Entomology planted the seed of 20 of the more or less well-known varieties at Calvert, Tex. Each variety was represented by a plat 5 acres in extent. The soil was uniform throughout the acreage covered by this experiment. The test was a severe one on account of unusually unfavorable local conditions. The crop was made several weeks late by successive frosts early in the season. By a comparison with the results of the variety test conducted during the season of 1903, which

was noted in Farmers' Bulletin 189 of this Department, it will be seen that the general advantage of the early maturing varieties over the late maturing ones is again demonstrated. During that season the Herndon variety turned out to be the most prolific. This variety was not tested during the season of 1904, for the reason that it was impossible to procure seed. It was a local variety known in only one county in Mississippi, and seems to have died out on account of the general desire of planters for varieties which have large bolls.

In reality the superiority of the early maturing varieties would be more in evidence than the following grouping would indicate. In arranging the planting of varieties in the field the earlier ones were placed nearest the timber. It was designed to have the varieties graded from the vicinity of the timber according to their relative earliness. Consequently the King variety was nearest the timber, and the Russell most removed. As is usual in such cases, the weevils appeared in the cotton near the timber first. For two weeks before any of the pests had appeared in the middle of the field they were causing considerable damage in the plats nearest the timber.

It is not possible to give varieties of cotton a complete test during a single season. The only correct basis for an estimation of the value of different varieties in weevil-infested regions is a repetition of experiments during several seasons. As has repeatedly been found to be the case in the tests of varieties of cotton which have been conducted by southern experiment stations, the changing climatic conditions alter the relative standing of the varieties very materially. In some cases a variety found during one season to be at the head of the list in production may, during the following season, fall far below. Work that has been conducted elsewhere in Texas indicates some probable modifications of general conclusions that might be drawn from this test. For instance, the Rowden variety would probably rank considerably higher than was the case in these experiments. Nevertheless, it is believed that the test conducted by the Bureau of Entomology in Robertson County will furnish the basis for a general idea of the value of some of the principal known varieties.

The lint from the varieties was given commercial grading as specified in the accompanying table, by a special committee of members of the Galveston cotton exchange, appointed at the suggestion of the writer by the president of the exchange.

The name "Georgia Truitt" applies to the seed of the well-known Truitt variety from Georgia. The name "Texas Truitt" is used to differentiate the cotton grown from Truitt seed which had been planted in Texas for one year. The same distinction applies to the names "King" and "Texas King."

Comparison of cotton varieties.

Variety.	Yield per acre, seed cotton.	Percentage of lint.	Rank by yield.	Class.	Staple.
	Pounds.				
Territory	885.4	28.17	2	Barely low middling	Weak.
Georgia Truitt	749.0	27.76	5	Strict good ordinary	Fair.
Shine	670.4	32.07	6	Low middling	Do.
Dickson	436.2	28.91	14	Low middling to strict low middling.	Poor.
Texas King	599.2	29.25	7	Strict low middling	Fair.
Meyers	483.8		12	Strict good ordinary	Do.
Van Nose	525.6		11	....do	Do.
Texas Truitt	511.4	27.75	8	....do	Poor.
King	863.4	31-32.53	3	Strict low middling	Do.
Native	427.2	33.28	16	....do	Fair.
Russell	387.0		17	Good ordinary	Poor.
Tool's	944.8	30-34.43	1	....do	Very poor.
Rowden	214.2		22	Low middling	Good.
Berry	338.8		19	Strict good ordinary	Very poor.
Parker	566.6	29.95	9	Low middling	Good.
Texas King	599.2	27.74	7	Strict good ordinary	Fair.
Mascott	534.4	33.52	10	Strict low middling	Do.
Otto	398.0	33.23	16	Good ordinary	Poor.
Hawkins	845.0	32.33	4	Good ordinary to strict good ordinary.	Do.
Culpepper	235.0		21	Strict good ordinary	Fair.
Eudaly	361.8		18	Good ordinary	Poor.
Native	428.6		15	....do	Do.
Hetty	476.0	31.82	13	Low middling	Fair.
Welborn	323.2		20	Strict good ordinary	Do.

Arranged according to production, these varieties may be grouped in the following manner:

First group, yielding from 700 to 1,000 pounds of seed cotton per acre: Tool's, Territory, King, Hawkins, Georgia Truitt.

Second group, yielding from 500 to 700 pounds of seed cotton per acre: Shine, Texas King, Texas Truitt, Parker, Mascott.

Third group, yielding from 400 to 500 pounds of seed cotton per acre: Van Nose, Meyers, Hetty, Dickson, Native.

Fourth group, yielding from 200 to 400 pounds of seed cotton per acre: Russell, Eudaly, Berry, Welborn, Culpepper, Rowden.

Arranged according to class, the above-mentioned varieties may be ranked in the following manner:

Fair: Texas King, King, Native (No. 10), Mascott.

Middling Fair: Dickson.

Good Middling: Shine, Rowden, Parker, Hetty.

Middling: Georgia Truitt, Texas Truitt, Meyers, Van Nose, Berry, Texas King, Culpepper, Welborn.

Low Middling: Territory.

Good Ordinary: Hawkins.

Ordinary: Russell, Tool's, Otto, Eudaly, Native (No. 23).

The two "natives" represented two different lots of seed.

Arranged according to staple, the varieties stand as follows:

Good: Rowden, Parker.

Fair: Georgia Truitt, Shine, Texas King, Meyers, Van Nose, Native, Mascott, Culpepper, Hetty, Welborn.

Weak: Territory.

Poor: Dickson, Texas Truitt, King, Russell, Otto, Hawkins, Eudaly, Native.

Very Poor: Tool's, Berry.

Arranged according to the average rank by class and staple, the varieties could be grouped in the following manner:

First Group: Texas King, Native (No. 10), Mascott.

Second Group: Rowden, Parker.

Third Group: Shine, King, Hetty.

Fourth Group: Georgia Truitt, Dickson, Meyers, Van Nose, Texas King, Culpepper, Welborn.

Fifth Group: Texas Truitt.

Sixth Group: Territory.

Seventh Group: Berry.

Eighth Group: Hawkins.

Ninth Group: Russell, Otto, Eudaly, Native.

Tenth Group: Tool's.

CONCLUSIONS REGARDING THE USE OF FERTILIZERS.

The Bureau of Entomology has not conducted any special tests of fertilizers. However, in the prosecution of a great number of the general experiments, it has been necessary to make use of commercial fertilizers. In view of the lack of exact knowledge regarding the proper use of fertilizers in Texas, due to conditions which are in many respects dissimilar to those in regions where experiments with fertilizers have been conducted, it is considered advisable to present some of the incidental results along this line.

The uncertainty connected with field experiments during a single season is nowhere more marked than in the use of fertilizers. The benefits derived from the use of fertilizers depend upon soil and climatic conditions, as well as upon the preparation the ground is given. The climatic conditions may cause some fertilizers to be available during one season, while during another season no results might be evident from their use. During the season of 1904, the results of the use of fertilizers were confusing. However, some of the results that are doubtless of more or less general application are referred to in the following paragraphs. That these conclusions are approximately correct is shown by the fact that they agree in a general way with the results of the various State experiment stations which have conducted fertilizer experiments in the South.

On sandy post-oak land in Robertson County, in one case the application of a fertilizer consisting of 200 pounds of cotton-seed meal and

100 pounds of acid phosphate per acre produced a yield of 900 pounds of seed cotton, which was 50 per cent more than the yield of the same variety of cotton in an unfertilized part of the same field. In another case, on similar soil in Robertson County, 200 pounds of acid phosphate (14 per cent available phosphoric acid) caused an increase of 163 pounds of seed cotton per acre. On river-bottom soil in Robertson County an application of 140 pounds of cotton-seed meal with 140 pounds of acid phosphate per acre caused an increase in yield of 180 pounds of seed cotton per acre. In this locality, as well as on alluvial soil in Wharton County, the application of 200 pounds per acre of acid phosphate having 14 per cent of available phosphoric acid did not increase the yield appreciably.

The most striking results from the use of fertilizers were obtained in the case of the work conducted in Washington County on heavy, sandy river-bottom soil, which had been planted in cotton or corn for at least fifteen years. The application of 200 pounds of acid phosphate increased the yield about 20 per cent. The application of 300 pounds of this fertilizer increased the yield in the neighborhood of 50 per cent, not only in the case of improved varieties, but also in the case of native cotton. The largest yields obtained anywhere during the season by the Bureau of Entomology were in this location. One field of native cotton, fertilized with 300 pounds of acid phosphate, yielded at the rate of 1,712 pounds of seed cotton per acre. Two other plats fertilized at the same rate yielded 1,632 and 1,437 pounds of seed cotton per acre, respectively. Some of the plats fertilized with the amount of acid phosphate that has been mentioned did not yield nearly as high; nevertheless the average on the fertilized plats reached in the neighborhood of 1,000 pounds of seed cotton per acre as against an average yield of 527 pounds of seed cotton per acre in the case of unfertilized plats.

Upon black prairie soil in Karnes County, 200 pounds of acid phosphate per acre on the average, with several different varieties of cotton, increased the yield considerably. On 30 acres of early maturing varieties and native cotton, the amount mentioned resulted in a net gain of $5.65 per acre. Heavier applications of acid phosphate, at 400 and 500 pounds per acre, did not result in a net gain greater than that mentioned in the application of 200 pounds. On the same plantation an application of 300 pounds of a complete fertilizer, analyzing 8 per cent phosphoric acid, 2 per cent nitrogen, and 2 per cent potash, caused an increase in the yield per acre of 253 pounds of seed cotton, resulting in a net gain per acre of $5.07.

A careful consideration of the subject of the fertilization of cotton in Texas, by Prof. R. L. Bennett, will be found in Bulletin No. 75, Texas Agricultural Experiment Station.

RELATION BETWEEN SEPPA COTTON AND WEEVIL DAMAGE.

The winter of 1903–4 was unusually mild in Texas. The consequence was that the region in which volunteer cotton occurred extended much farther north than normally. Some volunteer cotton occurs in Texas every year, but its occurrence north of about the latitude of Victoria is unusual. During the year 1903–4 much volunteer or seppa cotton was found as far north as Milam County. A line through the middle of Milam, Williamson, Travis, and Hays counties would indicate the northward limit of the territory in which seppa cotton occurred during the season. In many fields in Karnes, Wilson, and other counties practically every root of the preceding year overwintered. It must be evident to any observer that this condition must conduce to the most successful hibernation of the weevils. They are provided with food practically throughout the winter, and in the spring there is an abundance of green sprouts long before the planted cotton has come up. The consequence is that there is a much smaller mortality rate during the winter in this region than elsewhere. The very great damage which was done in 1904, in the counties of southwest Texas last mentioned, was due to the occurrence of this seppa cotton. By the latter part of June it was found that in some localities practically all the fruit on these plants had become infested. This resulted in at least one additional brood of weevils to prey upon the planted cotton.

The Bureau of Entomology has repeatedly pointed out that the presence of volunteer cotton is the greatest menace to the crop that exists in southern Texas. The encouragement of such plants is undoubtedly the worst possible practice in weevil-infested regions. The disastrous experience of many counties in the southern portion of the State during the past season has abundantly demonstrated the force of the warnings that have been issued from time to time. The staple produced upon seppa plants is exceedingly short and weak, and is not desired by the trade. Before the advent of the weevil, the only reason for encouraging such growth was to procure the first bale. Now, on account of the fact that the presence of such plants intensifies the seriousness of the weevil problem, any attempt to produce cotton from the stalks of the preceding year should by all means be discouraged. The proper procedure would be to destroy all the plants in the field early in the fall, as suggested in the list of recommendations.

EXPERIMENT IN DEFERRED PLANTING.

In Texas some little attention has been attracted to the proposal of eradicating the boll weevil by deferring the time of planting until very

late in the season. The idea has been that by following with such a practice after the early destruction of the plants in the fall the hibernating period of the weevils could be so lengthened that all would perish. From superficial considerations it would seem that late planting instead of early planting would be the proper way to avoid damage by the pest. In order to determine this point definitely, the Bureau of Entomology conducted a special experiment at Victoria, Tex., during the season of 1904. A field was selected which was isolated from all other cotton fields by a dense growth of huisache, the nearest cotton being nearly a mile away. The field under consideration was 20 acres in extent and had been planted in cotton during the season of 1903, when the weevils became very numerous. The stalks were removed in the latter part of November. During the spring sprouts sprang from a number of the roots remaining in the ground, but these were destroyed with hoes from time to time. After this preliminary treatment the field was planted in King cotton on May 23. The climatic conditions in general were favorable, resulting in a rapid growth. On July 15 an examination showed that the weevils were generally distributed throughout the field, although the damage at this time was not great. On August 3, however, it was found that 90 per cent of all the squares in various parts of the field were infested. By August 31 no blooms whatever were to be seen. A small number of bolls were in evidence, but very few of them were open. This field yielded altogether only 3,240 pounds of seed cotton, less than one-tenth of a bale of lint per acre.

As a check upon the foregoing experiment another isolated field was selected which had been in cotton continuously for seven years. In this case 5 acres were planted with seed of the Parker variety of cotton during the last week in February. It was found that weevils made their appearance in this field in great numbers at approximately the same time as they appeared in the field planted very late. The total yield on the 5 acres planted in February was 6,990 pounds of seed cotton, or 1,398 pounds per acre.

As against a yield of about one-tenth of a bale per acre in the late-planted field we have, in the early-planted one, a yield of nearly a full commercial bale per acre.

The evident conclusion from this experiment is that even under the most favorable circumstances late planting can not be relied upon to save the crop. Aside from the general difficulties in late planting and the likelihood that the crop will be damaged by the other insect pests, it seems that a number of weevils sufficient to thoroughly infest the field in a short time succeed in passing the prolonged period of hibernation. The late-planted cotton grew well, and the only important factor in reducing the yield was the boll weevil.

CONTROLLING THE BOLL WEEVIL IN COTTON SEED AND AT GINNERIES.

The possibility of controlling the boll weevil in cotton seed and at ginneries received special attention during the season of 1904.

The Bureau of Entomology employed a ginning expert, and many experiments were conducted with gins in actual operation. The results of this work have received full consideration in Farmers' Bulletin No. 209 of this Department, which may be had upon application. In this connection it is sufficient to state that the facility with which weevils may be transported from infested to uninfested localities in cotton seed has been fully demonstrated, and the exact points where danger may be avoided in the process of ginning have been determined. The two means of preventing danger from the transportation of weevils in cotton seed are (1) the fumigation of the seed, and (2) the application in ginneries of the devices that will more or less effectually remove the weevils from the seed. For detailed information the reader is referred to Farmers' Bulletin No. 209.

SUPPOSED IMMUNITY OF MEXICAN COTTONS.

Reported immunity from boll weevil attack of certain so-called Mexican tree cottons, with their possible value in the cotton-growing States, was investigated by an agent of the Bureau of Entomology during the month of September, 1904. As these cotton trees were said by their promoters to produce their first lint the second season from the date of planting, it was evident that if they were found to be affected by frosts their immunity from the boll weevil, if such a condition existed, could be of no practical value in this country. Persistent reports,[a] however, concerning the ability of the tree cotton to withstand frosts and its immunity against the attacks of the boll weevil, made it desirable for the Bureau to obtain reliable information at first hand.

Tree cotton grown from seed received from the locality in Mexico and from the cotton planter from whom practically all of the above-mentioned reports emanated, was observed by the representative of

[a] The following quotation from a daily newspaper illustrates the character of the reports referred to: "The plant begins bearing when five years old and continues to be productive for half a century or more. In some instances a single tree is known to produce as much as 59 pounds of cotton in one season, the fiber being very similar to that of the cotton plant and adaptable to the same uses. It is immune against the boll weevil and all other insect pests, and, under proper conditions, the growing of it may be immensely profitable." The Mexican cotton planter, to whose cotton trees the above and like current reports referred, in a letter to a gentleman in Mexico City, a copy of which the writer has seen, states that the "tree cotton" begins to produce staple in paying quantities at the age of *two years*.

the Bureau growing under various conditions of soil, climate, and elevation. The most significant conditions were found at San Bartolo, State of San Luis Potosi, Mexico, at the hacienda of Espinosa y Cuevas Hnos., this being the only locality where tree cotton was found growing for which accurate temperature records were available. A comparison of these records with the United States Weather Bureau records at Brownsville, Tex.—which point represents the mildest climate of the cotton belt of the United States—shows that both the minimum and daily mean temperatures of the two places are very nearly alike during the winter months. At the Mexican hacienda referred to, the owners state that the tree cotton was injured by the light frosts during the winter of 1902–3 to the same extent as was the American upland cotton growing there. An examination of many squares of the tree cotton plants showed that fully two-thirds of them were infested by the boll weevil. At Cuernavaca, State of Morelos, Mexico, the squares of a variety of cotton known among the natives as Algodon Arbol (cotton tree) were found to be badly infested by the boll weevil. At all places where Mexican tree cotton was found entirely free from the boll weevil it was undoubtedly due to the nonexistence of the insect in that section.

The observations mentioned in the foregoing paragraphs lead to the conclusion that there is no variety of cotton in Mexico which is immune to the boll weevil. This conclusion is borne out by experiments conducted at Victoria, Tex., with cotton plants grown from the seed of a large number of varieties procured in Mexico and Cuba.

FUTILE METHODS SUGGESTED FOR CONTROL.

In some quarters of Texas and Louisiana there is still considerable misunderstanding about the habits of the boll weevil, and many fallacious suggestions are proposed from time to time. The supposition exists in many quarters that the boll weevil is attracted to lights. A number of machines based upon this idea have been constructed. The possibility of attracting the boll weevil to lights was one of the first matters relating to the pest to be investigated by entomologists. During September, 1897, Mr. J. D. Mitchell, of Victoria, Tex., a naturalist and cotton planter, set out trap-lanterns in cotton fields in Victoria County for one night. The insects captured were sent to the Bureau of Entomology for examination. In all 24,492 specimens were taken, representing approximately 328 species. Divided according to habit, whether injurious or beneficial, the result was: Injurious species 13,113 specimens, beneficial species 8,262 specimens, of a neutral character 3,117. The interesting point in connection with this experiment was the fact that not a single specimen of the boll weevil was found, although the lights were placed in the

midst of a field where the insects were very abundant. Since that time other investigators have looked into the matter carefully. Lights have been kept burning in cotton fields. In no case has a single specimen of the boll weevil been captured in this manner, although thousands of species of insects have been taken. The public misapprehension about the possibility of capturing the boll weevil with lights is due to the fact that a somewhat similar insect, *Balaninus victoriensis*, and other acorn weevils, differ from the boll weevil in that they fly at night and lights exert a strong attraction for them. During certain seasons the acorn weevils are exceedingly common in Texas, and great numbers of them fly to the electric lights.

The old idea, the fallacy of which has been explained repeatedly by entomologists for the past fifty years, that sulphur can be forced into the system of plants to make them immune to insect attack, sometimes creeps out with reference to the boll weevil. The method is entirely useless. Sulphur is not soluble either in water or acids. It is consequently impossible for it to be taken up by the plants. In chemical combinations, in which forms only could it be assimilated by the plants, there is nothing to indicate that it would have special insecticidal properties. The usual form in which the use of sulphur has been recommended in Texas is that the seed should be soaked before planting in water containing it. Money used in this manner is entirely wasted.

Undoubtedly the most important fallacious remedy that has ever been proposed for the boll weevil is Paris green, which received a great deal of attention during the season of 1904. The urgent demand for a specific remedy on the part of the planters was evidenced by the extensive use of this substance. At least 25 carloads were used in Texas during three months. A portion of the great attention that Paris green attracted was due to the fact that early in the season a certain number of weevils may be killed by it. The number destroyed in this manner early in the spring really means nothing whatever to the crop later, when the plants have put on squares and the poison no longer reaches the pest. It has been demonstrated that the great majority of the weevils do not emerge from hibernating quarters until the plants begin to put on squares. Those that emerge in this manner can not be affected by any amount of Paris green that might be applied. The Bureau of Entomology has had fields dusted repeatedly throughout the season, but without benefit. The results of many experiments with Paris green will be found in Farmers' Bulletin No. 211 of this Department.

Among the futile means of controlling the boll weevil the large number of machines that have come to public attention from time to time must be included. There is some possibility that ultimately an

effective machine may be perfected. Careful tests which have been made with all those proposed up to the present time, however, do not show any decided hope in this direction. These machines have been designed to poison the insects, to jar them and the infested squares from the plants, to pick the fallen squares from the ground, to kill by fumigation, and to burn all infested material on the ground. It is estimated that over one thousand machines of a certain class, designed to jar the weevils and infested squares from the plants, were sold in Texas during the season of 1904. The testimony of all users of these machines is now to the effect that they are entirely useless as far as the increasing of the crop is concerned. As each one of these machines was sold for $40, the loss to the people of the State can be seen to be very great. By such means it is, of course, possible to capture a certain number of weevils in the field. The great number remaining and their rapid rate of multiplication render this small number entirely inconsequential.

The Bureau of Entomology follows the general policy of investigating all machines that are proposed; but no machine has yet been found sufficiently effective to be recommended. In fact, there seems at present to be little probability that such a machine will ever be perfected.

A great number of poisons to be used as sprays and in other forms have been proposed. It is usually supposed that some exceedingly toxic substance has been discovered which, in a very diluted quantity, will kill the insects with which it comes in contact. Other applications are designed to repel the insects from the plant by some supposedly offensive property. It is almost needless to state that all these proposed remedies are entirely without value.

QUARANTINES AGAINST THE BOLL WEEVIL.

In the attempt to prevent the introduction of the boll weevil several State legislatures have enacted laws which either in themselves restrict the shipment of commodities believed to be likely to convey the pest, or authorize State crop pest commissions or State entomologists to promulgate and enforce rules and regulations to this end. Unfortunately there is very little uniformity in State regulations now in force. Some States have quarantined articles that are admitted unrestrictedly by others, and, moreover, from time to time numerous modifications of the regulations based upon these laws have been made. This has resulted in endless confusion to shippers and transportation companies. The natural commercial course of at least 5,000 carloads of Texas farm products was either interfered with decidedly or prevented entirely by the operation of these laws during the season of 1904. In view of this situation the Department of Agriculture suggests the following plan for a State law, providing for quarantines,

as well as for eradicating possible isolated colonies that may be discovered, and also providing a means of enforcing remedial work at the earliest possible moment. It would be decidedly to the interest of all the States concerned to bring their regulations into conformity with these suggestions as soon as possible. The Department's suggestions are based upon a careful study of the habits of the boll weevil during several seasons, as well as upon knowledge gained from a large amount of inspection work which devolved upon the Bureau of Entomology in consequence of the State laws now in effect. It is believed that they will furnish sufficient protection and at the same time not interfere unnecessarily with shipping. They are based upon the suggestions toward a uniform quarantine system adopted by representatives of practically all the principal cotton-producing States who met at Jackson, Miss., August 2, 1904, with such modifications as seem advisable as a result of the subsequent study by the Bureau of Entomology of the means by which the pest is disseminated.

SUGGESTIONS FOR A UNIFORM STATE BOLL-WEEVIL LAW.

(1) Plenary authority should be delegated to a board, the executive officer of which should be an entomologist, to take whatever steps may be found necessary for eradicating or controlling the boll weevil.

(2) A prohibition against bringing into the State, or having in possession, live boll weevils should be included, with a suitable penalty affixed.

(3) Definite authority should be given the officer or officers in charge of the boll-weevil quarantine matters to establish from time to time such rules and regulations as may be necessary.

It is considered that the foregoing provisions are sufficient for the law itself. Many other matters growing out of quarantine work deal with changing conditions and consequently should be covered by rules and regulations which may easily be changed as the occasion demands. These regulations should include an absolute quarantine against cotton seed, seed-cotton, cotton-seed hulls, baled cotton (whether compressed or flat), and corn in the shuck from infested territory. The basis for this recommendation is that the weevil has been found to be transported easily in cotton seed and other cotton products. As will be specified later, there is, under some conditions, considerable danger in the shipment of baled cotton. Corn in the shuck is included for the reason that it often furnishes hibernating quarters for weevils. This absolute quarantine should be modified to the extent of allowing the shipment of any of the foregoing articles after they have been properly fumigated under the direction of the Bureau of Entomology. The quarantine should be directed against all territory infested or

which may become infested, rather than against a list of certain counties.

A long list of other farm products have been quarantined by various States. This list includes hay, wheat, oats, cowpeas, fruit, vegetables, rice, and rice products. The Department of Agriculture does not consider that there is any appreciable danger in the shipment of these commodities at any time of the year. Numerous examinations that have been made have failed to reveal the presence of weevils, and since from the previous extensive shipping from infested portions of Texas to all parts of the South no infestation has been found to have resulted, it can not be considered necessary to extend quarantines to cover these products. It is true that there may be danger in such shipments under certain circumstances, nevertheless there seems to be no more danger in connection with these articles than there is in the shipment of general merchandise or in the interstate movement of empty box cars. The boll weevil does not feed upon any of these articles. Specimens may possibly occur among them, but their presence seems no more likely in such situations than in any articles of commerce which may be stored in the neighborhood of cotton fields, or which may pass through regions where cotton fields from which weevils might fly at any time are situated in the vicinity of the railroad. The work which has been conducted by the Bureau of Entomology, in cooperation with the Louisiana crop pest commission, has given many opportunities for determining whether certain farm products are likely to convey the boll weevil. Every colony found in Louisiana during 1904 has been studied carefully. In no case has there been any suspicion that the pest was conveyed to new regions in any commodities except those against which a provisional absolute quarantine is suggested.

It does not seem feasible to allow the shipment of certain commodities during some months and exclude them during others. Some of the rules and regulations now in effect quarantine hay, for instance, except during July, August, and September. The supposition in these cases has been that during those months the weevils will be found in the cotton fields, while during the remainder of the year they may have taken flight to hibernation quarters, thus infesting a large number of commodities that would be uninfested during the other months. As a matter of fact, it has been found that there is usually an extensive flight of weevils as early as the middle of August. Shipment of hay or moss would therefore be practically as dangerous during summer as at any other time of the year. However, it is not considered that such danger at any time is great enough to warrant the inconvenience that is caused shipping interests by the enforcement of quarantines.

Some of the States have also quarantined bedding used by common carriers with shipments of live stock. The Department does not

consider that there would be any danger whatever in the use of hay or straw for this purpose.

Household goods have caused great confusion in quarantine regulations. The origin of the quarantine of household goods on the part of several States was the knowledge of very extensive emigration of negro tenants from infested portions of Texas to all parts of the South. It is the custom of such emigrants to carry along small quantities of special cotton seed, as well as to use cotton seed or seed cotton in packing furniture and other articles. As these practices involve the possible shipment of some of the commodities which should be quarantined, it is suggested that the shipment of household goods should be prohibited in all cases where the consignments are not accompanied by affidavits attached to the waybill stating that no cotton seed or other articles named as dangerous in a preceding paragraph are included.

The quarantine officer should have ample authority to modify, in special cases, whatever rules and regulations are promulgated. Such special cases might occur, for instance, in the treatment of baled cotton. There is no doubt that a general quarantine should be enforced against this product. There is considerable danger in shipping baled cotton to mills where cotton fields are adjacent, since the bagging around bales that have been stored near gins in infested territory might easily carry weevils. Nevertheless, a general quarantine should not be made to apply to shipments of baled cotton to mills in the cities, or to shipments to ports for direct export. Many similar cases where special action may be necessary will arise from time to time. The best method for providing for such cases is to grant considerable breadth of authority to the quarantine officer.

PRESENT QUARANTINES OF THE SEVERAL STATES.

Quarantines designed to prevent the importation of the boll weevil are now in force in the following six States: Alabama, Georgia, Louisiana, Mississippi, North Carolina, South Carolina. They are directed against all counties in Texas and parishes in Louisiana that are indicated as infested on the map on page 12, as well as against such counties or parishes as may become infested in the future. The following pages give the substance of the present restrictions. For further particulars the quarantine officers of the several States should be addressed directly.

Alabama.—The following act of the Alabama legislature was approved October 6, 1903:

AN ACT To prevent and prohibit the importation of seed from cotton affected with the Texas boll weevil.

SECTION 1. *Be it enacted by the legislature of Alabama*, That no person shall import or bring into the State of Alabama any seed from any cotton affected with what is

known as the Texas boll weevil, nor the seed from any cotton from any place where the cotton has been affected with said boll weevil.

SEC. 2. Any person who violates the provisions of section 1 of this act shall be guilty of a misdemeanor, and on conviction shall be fined not less than ten dollars ($10) and not more than five hundred dollars ($500).

(H. 877, No. 559, approved October 6, 1903.)

Recently (January 25, 1905) the State board of horticulture of Alabama has adopted quarantine regulations against the boll weevil, based upon the recommendation for a uniform system of quarantine rules made by the association of official entomologists of the cotton belt, an association consisting of State entomologists, together with agents of the Bureau of Entomology of this Department. By these regulations an absolute quarantine is established at all seasons of the year against cotton seed, seed cotton, hulls, cotton-seed and seed-cotton sacks which have been used, cotton picker's sacks, corn in the shuck, unsacked corn, unsacked oats, unsacked wheat, and unsacked cowpeas. During the months of July, August, and September there are no restrictions against the importation of hay, straw, sacked wheat, sacked oats, sacked shelled corn, sacked cowpeas, and unbaled Spanish moss, but during the remaining nine months of the year the importation into the State of any of these articles from quarantined counties or parishes is prohibited. Through shipments of quarantined articles may be made in cars which must be tightly closed, and no unloading is allowed during transit through the State. Household goods to be shipped from the infested territory into the State of Alabama must be accompanied by an affidavit attached to the way bill stating that no quarantined articles are contained in the shipment as packing or otherwise. Baled cotton can be shipped into the State only in tightly closed cars.

Particulars regarding the Alabama quarantine regulations may be obtained by addressing Prof. J. F. Duggar, Experiment Station, Auburn, Ala.

Georgia.—Previous to August 15, 1904, the Georgia State board of entomology had authority, by virtue of the legislative act which created it, to enact such regulations as it deemed necessary to prevent the introduction or dissemination of injurious crop pests or diseases. On August 28, 1903, this board adopted a regulation prohibiting the introduction of cotton seed from Texas except under a certificate from an authorized State or Government entomologist stating that the seed had been fumigated in such manner as to kill any stage of boll weevils which might be contained therein. On August 15, 1904, an act of the general assembly of the State of Georgia was approved whereby cotton seed, seed cotton, cotton-seed hulls, or cotton lint in bales or loose, oats, hay, fodder, husks, straw, forage of any kind, corn in the husk,

or all material packed in anything originating on a farm or plantation, is prohibited from being brought into the State except when there is attached thereto a certificate signed by an authorized State or Government entomologist to the effect that said material was grown in and was shipped from a point where, by actual inspection, the Mexican cotton boll weevil was not found to exist.

Mr. R. I. Smith, Capitol, Atlanta, is the present quarantine official in Georgia.

Louisiana.—A special session of the State legislature enacted a law approved December 15, 1903, creating a Louisiana crop pest commission, which was authorized to promulgate and enforce such rules and regulations as seemed necessary in order to prevent the further spread or introduction into the State of the Mexican cotton boll weevil. The original rules and regulations of this commission were adopted on February 5, 1904, and since then have been amended in many particulars. At first prohibiting the importation of all farm products from practically all cotton-producing counties in Texas, they were afterwards modified, at the suggestion of and by arrangement with the Bureau of Entomology, in such a manner that all farm products except cotton seed, seed cotton, hulls, cotton-seed and seed-cotton sacks, hay, and straw were accepted for importation from Texas into Louisiana on the certificate of the Entomologist of the United States Department of Agriculture or his duly accredited representative. Corn, wheat, oats, and other grains, and cowpeas, by this arrangement, were to be certified to only during the months of July, August, and September. On December 14, 1904, the crop pest commission raised all quarantine restrictions on the last-mentioned commodities. Cotton seed, seed cotton, hulls, cotton-seed and seed-cotton sacks, hay, and straw in any form, whether as a packing for household goods, stuffing for mattresses, pillows, and cushions, or feed for stock, are absolutely prohibited from being shipped into Louisiana from 131 listed counties of Texas considered to be infested, as well as all others which may become infested with the cotton boll weevil, or from being shipped from an infested parish in Louisiana into an uninfested parish. Shipments through the State of quarantined articles must be handled in original tightly closed cars without unloading at any point within the State.

The present regulations prohibit the importation of household goods from infested localities when any of the above-mentioned quarantined articles are used as packing or in any other way. Shipments of mattresses, pillows, and cushions, filled with cotton, hay, straw, shucks, or other quarantined articles, are prohibited. Shippers are required to execute affidavits to the effect that mattresses, etc., have been filled with the substance contained for at least eighteen months before

shipment, otherwise such articles must be emptied. The affidavit is to accompany the way bill.

Mr. Wilmon Newell, Shreveport, La., is the quarantine officer of this State.

Mississippi.—An act of the State legislature entitled "A boll weevil quarantine act," approved March 18, 1904, empowers the State entomologist to prevent in every possible and practical way the introduction of the Mexican cotton boll weevil into that State by adopting and enforcing rules and regulations governing the transportation of farm products. A quarantine was instituted against 131 Texas counties and one Louisiana parish, as well as all other communities and parishes in which the boll weevil might be found to exist. The quarantined articles included cotton seed, cotton-seed hulls, cotton-seed meal, sacks used to hold these materials, hay, oats, straw, and corn. Nursery stock, fruit, and garden truck were accepted under these rules only when accompanied by a certificate of inspection by the Entomologist of the United States Department of Agriculture. All farm products passing through the State of Mississippi were required to be in tightly closed cars and not opened, unloaded, or sidetracked for more than twelve hours during transit across the State. These rules were amended to permit, during the summer months, the unrestricted shipment of oats into and through the State. On September 1, 1904, the rules and regulations referred to above were rescinded in toto, and a new set of rules went into effect, based on the recommendations for a uniform system of quarantine rules by the association of official entomologists of the cotton belt. These rules and regulations specify the same quarantined territory as did those for which they were substituted. An absolute quarantine is established against cotton seed, seed cotton, hulls, seed-cotton and cotton-seed sacks (which have been used), cotton-pickers' sacks, corn in the shuck, unsacked corn, unsacked oats, unsacked wheat, and unsacked cowpeas from the quarantined territory. During the months of July, August, and September there are no restrictions against the importation of hay, straw, sacked wheat, sacked oats, sacked shelled corn, sacked cowpeas, unbaled or baled Spanish moss, but during the remaining nine months of the year all of these articles from quarantined counties and parishes are prohibited from entering the State of Mississippi. Through shipments of quarantined articles must be in tightly closed cars, which must not be unloaded while in transit through the State. Household goods to be shipped from the infested territory into the State of Mississippi must be accompanied by an affidavit to the effect that no quarantined articles are contained as packing or otherwise in the shipment. Baled cotton can be shipped into the State only in tightly closed cars.

Prof. G. W. Herrick, Agricultural College, Miss., is the quarantine officer of this State.

North Carolina.—By virtue of authority from the State legislature, to prevent the importation of crop pests, the North Carolina crop pest commission early in 1904 adopted rules establishing a quarantine against all localities where the Mexican cotton boll weevil is known to exist. The quarantine was absolute, and applied to cotton, cotton seed, cotton-seed meal, cotton-seed hulls, hay, oats, corn, rice, straw, rice chaff, and other grain or material likely to harbor any stage of the boll weevil. On August 15, 1904, new quarantine regulations were adopted and substituted for the previous ones, conforming very nearly with the recommendations of the association of official entomologists of the cotton belt, and also with the Alabama and Mississippi rules, which have been described in previous paragraphs. The North Carolina quarantine regulations now in force differ from those of the States of Alabama and Mississippi only in the following particulars: Cotton and cotton-seed meal are included among the articles against which the quarantine is absolute at all times. The restrictions concerning Spanish moss in the North Carolina regulations specify only unbaled moss, as do those of Alabama.

Prof. Franklin Sherman, jr., Raleigh, N. C., is the quarantine officer in this State.

Oklahoma.—The Oklahoma legislature is now considering a boll weevil quarantine act. At the time of writing, however, no definite action has been taken.

South Carolina.—In South Carolina, as in Alabama and Georgia, the quarantine regulations are entirely embodied in the laws of the State and consequently not as readily modified to conform with the changed conditions and a better understanding of the methods of dissemination of the boll weevil, as is the case when authority to promulgate rules and regulations is invested in a commission or in the State entomologist. The law established to guard against the introduction of the Mexican boll weevil into the State of South Carolina was approved on February 25, 1904. The commodities quarantined against were cotton seed, oats, and prairie hay, shipped directly or indirectly from infested points in the State of Texas.

Prof. C. E. Chambliss, Clemson College, South Carolina, can furnish information concerning the interpretation of this law.

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